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dition of things, and even some of the editions which have a very high reputation contain emendations which are entirely foreign to Kant's mode of thought and expression. It may be of interest to note that the well-established tradition of regarding the fifth edition, which was the last that appeared during Kant's lifetime, as authoritative and of special importance has been set aside by Professor Erdmann, who takes pains to show that many errors have crept into all the editions subsequent to the second. But it was the fifth edition that Rosenkranz and Hartenstein, as well as Von Kirchmann, Adickes, and Vörlander fathered either altogether or in part. Dr. Erdmann for his part has gone back to the second edition, and to give some idea of the enormous extent of his labors it need only be said that he has indicated in a special volume printed as an appendix to the main work, and above noted, all the most important variations in the readings and emendations of the other chief editors, and that he has incorporated in an extensive series of footnotes in the work itself the results of his own textual and critical researches. His labors will, in a large measure, supplant those of his predecessors. The volume is, for its size, remarkably cheap.

Prof. Max Müller's English translation of the *Critique*, the second edition of which appeared some four years ago in this country, will be a valuable companion-piece to the German edition of Erdmann. It is a handsome volume, too well known to need comment, and should be accessible to all students. We miss the introduction of Noiré, but that has since been independently published in German. μ.

A BRIEF HISTORY OF MATHEMATICS. An Authorised Translation of Dr. Karl Fink's *Geschichte der Elementar-Mathematik*. By *Wooster Woodruff Beman*, Professor of Mathematics in the University of Michigan, and *David Eugene Smith*, Principal of the State Normal School at Brockport, N. Y. Chicago: The Open Court Publishing Co. 1900. Pages, xii, 333. Price, cloth, $1.50 net (5s. 6d. net).

Fink's *History of Mathematics* differs in several essential respects from existing English compendia. It is not biographical, it is not a collection of anecdotes of the great mathematicians, nor is it concerned with mathematical history as an integral portion of the general history of civilisation. It is rather a purely logical and systematic exposition of the evolution of the science, considered as an independent and organic whole, as a self-sufficient body of truth, developing along well-defined lines of its own, and having a perfectly definite physiognomy. Much has been gained in an economic respect by this mode of treatment, and it is sufficient to say that Fink's work contains within brief compass and at less cost more that really relates to the substance of mathematical history than any other work of like pretentions now in the field.

It is unnecessasy to comment upon the advantages that redound to mathematical instruction from a study of the history of mathematics. "The clearer view of the science that is afforded the teacher, the aspiration to improve his methods of presenting it, the increased interest in the class work, the tendency of the subject to combat stagnation of curricula," are, as the translators well remark, a few of the reasons that speak potently in its behalf. To the professional student a knowledge of it is absolutely indispensable to a correct conception of the present problems and status of his science as well as to a correct forecast of its potential future development; while to the philosopher and to the historian of science it is of more intensive value than the thoroughest acquaintance with the pure technique of any one of the mathematical disciplines in their present form. Here science is exhibited in its purest form, and the genesis of knowledge shown forth in its ideal types.

Fink has differentiated the history of the separate branches of mathematics in his treatment. He considers arithmetic, algebra, geometry, and trigonometry singly, carrying the historical development considerably beyond the limits of the ordinary undergraduate collegiate course. He takes up arithmetic first, considering in succession the development of number-systems and number-symbols among the Egyptians, Babylonians, Phœnicians, Greeks, Romans, Hindus, Arabs, and mediæval Europeans, discusses the development of the mechanisms and methods of computation, in the various forms of finger-reckoning, the abacus, etc., among the Romans, the Greeks, the Hindus, and their European successors; traces the development of the four species and their perfection, the arithmetic of fractions, the invention of decimals, etc., concluding with a consideration of the various phases which applied arithmetic has assumed in its modern developments. Algebra is considered next. Beginning with a survey of the general symbolism and the meagre operational signs which existed among the Egyptians, the Greeks, the Romans, the Hindus, the Chinese, and the Arabs, he traces the development of the embryonic theory of equations from Ahmes, the Pythagoreans, Archimedes, Eudoxus, Euclid, and Diophantus, through the works of the Hindus and the Arabs, to the epoch of the great Italian investigators of the sixteenth century and to their German and French successors of the period succeeding. This latter period is full of interest to the teacher and the student of elementary mathematics, who can study here in detail and with wonderful enlargement of insight the development of the marvellously economical notation and symbols of operations which now serve to abridge and illumine his labor. These men worked only with the meagerest elements of algebraical symbolism, and not only, for example, were the solutions of cubic equations obtained without so much as the sign for equality, but logarithms even were invented before the introduction of exponents, which now facilitate so much their comprehension.

The modern period begins with the founding of the great academies and the introduction of modern algebraical symbolism by Vieta, Harriot, Wallis, and Descartes. Pascal, Newton, and Leibnitz follow, with the invention of the Calculus and the development of the same by Euler, Lagrange, and the great modern mathematicians. Simultaneously, the development of the theory of numbers and the purely formal algebra is considered from the days of Fermat to the periods of Gauss, Grassmann, Hamilton, Dirichlet, and Dedekind. Finally, geometry and trigonometry are taken up. The beginnings of geometry among the Egyptians and Babylonians, its golden age in Greece, its dormancy among the Romans and their successors, its renaissance under Vieta, Kepler, Cavalieri, Roberval, Fermat, and notably under Descartes, its advancement by Pascal and Newton, the foundation of modern geometry by Monge, Carnot, Poncelet, Chasles, Mobius, Plücker, Steiner, and Von Staudt are the towering points of this development. Lastly, non-Euclidean geometry receives consideration.

As will be apparent from the preceding brief *résumé*, the work subserves in an eminently satisfactory manner the requirements of both practice and theory. For the biographical matter, which is common in the usual histories, but here omitted, an appendix of biographical notes alphabetically arranged has been substituted. The book has a thorough index, and it only remains to say that the work of the translators has been conscientiously and skilfully performed. μ.

GESCHICHTE DER PHYSIKALISCHEN EXPERIMENTIERKUNST. By *Dr. E. Gerland* and *Dr. F. Traumüller*. Leipsic: Verlag Wilhelm Engelmann. 1899. Pages, xvi, 442. Price, 14 marks.

For real intrinsic fascination, the history of the art of physical experimenting far surpasses that of the development of physical ideas; it is palpable and concrete, and so indissolubly connected with the history of the industrial arts and of material civilisation as to command the interest even of sociologists and of practical men, while certain theatrical features are not lacking to it that will compel the attention of even the general reading public. The present work by Dr. E. Gerland, professor in the Royal Mining Academy of Klausthal, and Dr. F. Traumüller, of the Nikolaigymnasium of Leipsic, both of whom are known for their labors in the history of science, will be found to subserve in an admirable manner the requirements which so extensive and important a task impose. It describes the ways by which physics has reached its present perfection, and portrays the mechanism and mode of operation of the instruments which have promoted its progress. The book is filled with reproductions of apparatus from the original editions of the great physicists, and with drawings of famous apparatus that have been preserved. Where possible, the descriptions also have been taken from the original works. In this manner, the authors believe that they have brought to light much that was unknown or forgotten. The history of the art of physical experimentation in antiquity, beginning with the Babylonians and Assyrians and ending with the Romans and the later Alexandrians, is passed in review, and many curious and ingenious instruments described, of the existence of which few people have the slightest idea. The Eastern Greeks and the Arabs then receive due notice, and the Middle Ages, the Renaissance, and the sixteenth century, which brought forth the works of Porta Gilbert, Leonardo da Vinci, and Stevinus, are afterwards considered. The period of Galileo, Kepler, Huygens, Newton, and Leibnitz, which overshadowed all the